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Vegetable Disease Control Recommendations for 1987

Richard X. Latin

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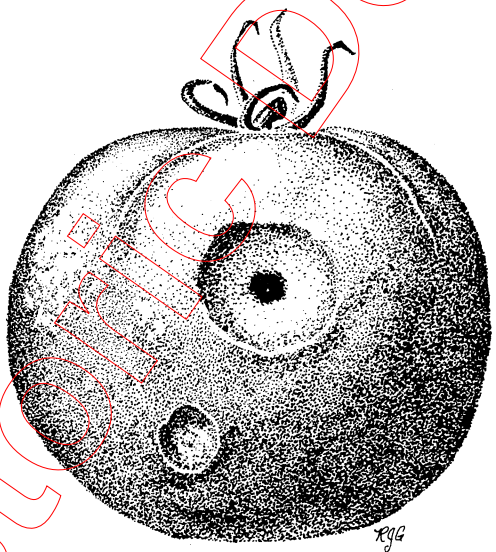
Purdue University Cooperative Extension Service



VEGETABLE DISEASE CONTROL RECOMMENDATIONS FOR 1987

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CONTENTS

Cooperative extension work in Agriculture and Home Economics, state of Indiana, Purdue University, and U.S. Department of Agriculture cooperating; H. A. Wadsworth, Director, West Lafayette, IN. Issued in furtherance of the acts of May 8 and June 30, 1914. The Cooperative Extension Service of Purdue University is an affirmative action/equal opportunity institution.

DISEASE CONTROL STRATEGY

This publication provides specific recommendations for controlling diseases in commercial vegetable crops. A sound disease control strategy involves more than application of a certain pesticide or use of a certain variety. It involves accurate diagnosis of crop disorders and an understanding of the other crop production factors that impact upon infectious plant diseases. A brief discussion of these important ingredients for successful disease management is provided below.

Disease diagnosis:

Diagnosis is an essential first step towards effective disease control. Several publications listed in the next section provide symptom descriptions that will help identify some diseases. Also, samples of diseased plant material may be sent to the Plant Diagnostic Clinic, Department of Botany and Plant Pathology, Purdue University, West Lafayette, IN 47907. Details for submitting specimens to the clinic can be obtained from local county agricultural extension agents.

Insect and weed control:

These plant pests often have a direct impact on disease severity by transmitting plant pathogens or by harbouring pathogens in the absence of the host crop. Control insects and weeds according to recommendations specified in ID-56 (see reference in the next section)

Soil fertility and pH:

Disease problems often are aggravated by soil nutrient imbalances and improper soil pH. Also, disorders associated with harmful soil conditions may resemble infectious diseases, often confounding efforts to identify the problem. Eliminate potential soil problems by collecting soil samples for analysis each year and by making appropriate ammendments where necessary.

Variety selection:

Use resistant varieties if possible and if they satisfy market requirements. The degree of resistance expressed by a variety may differ from one region to another. Therefore, always plant a test plot on your farm before planting large acreages to a new variety.

Rotation:

In additon to improving the general condition of field soils, crop rotation prevents the rapid build-up of plant pathogens that survive among plant debris. Successive years with the same or similar crops often result in serious disease epidemics that may overcome the effect of genetic resistance or protective fungicides.

Sanitation:

Sanitation involves obtaining seed and/or transplants that are disease free. It also concerns cleaning farm implements after working in diseased fields (This is especially important for highly contagious bacterial diseases and for plant pathogens that overwinter in soil.) Sanitation also should be practiced in greenhouses used for raising seedlings. The greenhouse structures and materials should be thoroughly cleaned and disinfested before starting a new crop.

RELATED PUBLICATIONS

Listed below are selected publications related to this bulletin. These and a list of other publications can be obtained from your local county agricultural extension office or from the Publications Mailing Room, 301 South Second Street, Lafayette, IN 47905.

BP 7	Reference Guide for Melon Disease Control
BP 8	Common Scab of Potato
BP 10	Directory of Fungicides for Indiana Vegetable Diseases
BP 13	Blossom End Rot of Tomato
BP 14	Bacterial Canker of Tomato
BP 15	Diagnosis and Control of Muskmelon Diseases
BP 17	Pumpkin Diseases and Their Control
ID 56	Indiana Vegetable Production Guide for Commercial Growers

CALIBRATION OF FUNGICIDE APPLICATION EQUIPMENT

Boom Sprayer Calibration

1. Clean sprayer and replace all worn or defective parts.
2. Fill tank with water.
3. Adjust spray pressure and speed of tractor for nozzle size and output using manufacturer's specifications.
4. Spray 1/4 acre (10,890 sq. ft.). Distance travelled will vary with boom width. For example, a 22 ft. boom must travel 495 ft. to cover 1/4 acre:

$$\frac{\text{1/4 acre (10.890 sq. ft.)}}{\text{boom width (22 ft.)}} = \text{distance to travel (495 ft.)}$$

5. Measure amount of water needed to refill the tank. This amount was applied to the 1/4 acre; thus, 4 times this amount is the gallonage per acre.
6. Adjustment in gallonage may be made either by varying tractor speed or by changing nozzle size. Recalibrate after making an adjustment.
7. Calculate acres covered by tank of spray soultion, and add required amount of fungicide for total area to be sprayed.

$$\frac{\text{tank size (gallons)}}{\text{gallons per acre}} = \text{acres per tank}$$

Adjustments for band applications

Since young plants occupy only a portion of the total area between row centers, fungicides can be applied in a band wide enough to cover plant foliage. This will result in considerable savings and maintain excellent fungicide protection. The simplest way to make the appropriate adjustments is to block nozzles whose spray does not reach the plant surface. Then determine the fraction of the area that actually is covered by the spray. For example, if the row width is 6 ft. and only 3 ft. is covered by the plant, then the fraction is 3/6 or, 0.5. Since half the area actually will be sprayed, then half as much of the recommended fungicde should be applied per acre.

FUNGICIDE REFERENCE GUIDE for selected vegetable diseases.

Fungicides registered for control of specific diseases are indicated by "x"

Crop	Disease(s)	anilazine	benomyl	captafol	captan	chlorothalonil	DCNA	dinocap	iprodione	mancozeb	maneb	metalaxyl	thiophanateM	TPTH	triadimefon	basic copper sulfate	copper hydroxide	cop. oxy. sulfate	copper resinate
		FUNGICIDE (Common Name)																	
Asparagus	rust									x	x								
Beans	anthracnose					x					x					x			
	bacterial blight															x	x		x
	halo blight																x		x
	rust					x					x								
	white mold		x				x						x						
Broccoli Cabbage Cauliflower	Alternaria leafspot					x					x					x	x		
	blackleg								x										
	blackrot																x		
	downy mildew					x					x	x				x	x		x
Carrot	Alternaria leafspot					x				x	x			x		x		x	
	Cercospora leafspot					x				x	x			x		x	x	x	
Cucumber Muskmelon Watermelon	Alternaria leafspot	x		x		x				x						x		x	x
	angular leafspot															x	x	x	x
	anthracnose	x	x	x	x	x				x	x					x	x	x	
	downy mildew	x		x	x	x				x	x	x				x	x	x	x
	gummy ~~mildew~~ stem blight	x		x		x				x	x								
	powdery mildew		x					x					x		\				

FUNGICIDE REFERENCE GUIDE for selected vegetable diseases.

Fungicides registered for control of specific diseases are indicated by "x"

		FUNGICIDE (Common Name)																	
		anilazine	benomyl	captafol	captan	chlorothalonil	DCNA	dinocap	iprodione	mancozeb	maneb	metalaxyl	thiophanateM	TPTH	triadimefon	basic copper sulfate	copper hydroxide	cop. oxy. sulfate	copper resinate
Onion	Botrytis (blast)	x				x			x	x	x								
	downy mildew				x	x				x	x	x							
	purple leaf blotch	x		x	x	x			x	x	x								
Pepper	anthracnose										x					x			
	bacterial spot															x	x		x
	Cercospora leafspot										x					x			
Potato	early blight	x		x		x				x	x			x		x	x	x	
	late blight	x		x		x				x	x	x		x		x	x	x	x
Squash Pumpkin	anthracnose	x	x		x	x										x		x	
	black rot	x				x													
	downy mildew											x							
	powdery mildew		x					x					x		x				
Tomato	anthracnose	x		x	x	x				x	x					x			
	bacterial speck															x	x		x
	Bacterial spot															x	x	x	x
	early blight	x		x	x	x				x	x					x	x	x	x
	gray leafspot	x		x	x	x				x	x					x			
	late blight	x		x	x	x				x	x	x				x		x	
	Septoria leafspot	x		x	x	x				x	x					x		x	x

Table 1. Common Names, Trade Names, Producers and Formulations of Selected Fungicides Registered for Vegetable Disease Control.

Common Name	Trade Name	Producer	Formulation
anilazine	Dyrene	Mobay	50WP
benomyl	Benlate	DuPont	50WP
captafol	Difolatan	Chevron	80DG
	Sprills		
captan	Captan	Stauffer	4F, 50WP, 80WP
	Captan	FMC	80WP
	Captec	Griffin	3F
	Orthocide	Chevron	50WP, 80WP
chlorothalonil	Bravo 500	Fermenta	4.17F, 75WP
DCNA	Botran	TUCO	75WP
dinocap	Karathane	Rohm & Haas	25WP, 4LC
iprodione	Rovral	Rhone Poulenc	50WP
mancozeb	Dithane M-45	Rohm & Haas	80WP
	Manzate 200	DuPont	80WP, 4F
maneb	Dithane M-22	Rohm & Haas	80WP
	Manzate	DuPont	80WP
	Manex	Griffin	3F
metalaxyl	Ridomil MZ-58	Ciba-Geigy	58WP
	Ridomil/Bravo	Ciba-Geigy	81W
thiophanate M (thiophanate methyl)	Topsin M	Pennwalt	70WP, 4.5F
TPTH (triphenyl-tin hydroxide	Du-Ter	Griffin	**30F
	Super-tin	Griffin	4F
triadimefon	Bayleton	Mobay	50WP
*basic copper sulfate	Basicop	Griffin	53WP
	Triangle Tribasic Copper Sulfate	Phelps-Dodge	53WP
		Citco	53WP
*copper hyroxide	Kocide 101	Griffin	50WP
	Kocide 606	Griffin	3F
*copper oxy-chloride sulfate	C-O-C-S	FMC	50WP
*copper resinate	Citcop 5E	Tennessee Chemical	**5EC

FORMULATION ABBREVIATIONS
WP = wettable powder, DG = dispersible granules, F = flowable suspension, LC = liquid concentrate, EC = emulsifiable concentrate

FORMULATION NOTES
Fungicides are sold commercially as a mixture of active ingredient (that which kills the fungus) and other substances i.e. carriers, diluents, solvents, wetting agents, emulsifiers, etc. The *formulation* indicates the portion of the product which is active ingredient and the physical form of the product. For WP and DG formulations, the number before the abbreviation indicates the percentage of the product that is active ingredient. For F, LC, and EC formulations, the number before the abbreviation usually** indicates the amount of the product that is active ingredient. For example, '50WP' describes a wettable powder that is 50% active ingredient; and '4F' describes a flowable product that contains 4 pounds of active ingredient per gallon of product.

*The number preceeding the type of formulation for *copper* products indicates the percentage or amount of *metallic copper* in the product. For example, "53WP" describes a wettable powder product that is 53 percent metallic copper, and "3F" describes a flowable product containing 3 lbs of metallic copper per gallon.

**For TPTH, the "30F" formulation indicates that the product contains 30 oz. of active ingredient per gallon. For copper resinate, the "5EC" formulation indicates that the product contains 5 percent metallic copper.

Table 2. Alphabetized list of selected fungicides by their trade names and corresponding common names.

TRADE NAME	COMMON NAME
Basicop	basic copper sulfate
Bayleton	triadimefon
Benlate	benomyl
Bravo 500	chlorothalonil
Captan	captan
Captec	captan
Citcop 5E	copper resinate
C-O-C-S	copper oxychloride sulfate
Difolatan	captafol
Dithane M-22	maneb
Dithane M-45	mancozeb
Du-Ter	trimethyltin hydroxide (TPTH)
Dyrene	anilazine
Karathane	dinocap
Kocide	copper hydroxide
Manex	maneb
Manzate	maneb
Manzate 200	mancozeb
Orthocide	captan
Ridomil	metalaxyl
Rovral	iprodione
Topsin-M	thiophanate methyl
Triangle	basic copper sulfate
Tribasic Copper Sulfate	basic copper sulfate

READ FUNGICIDE LABELS CAREFULLY FOR SAFE HANDLING AND APPLICATION INSTRUCTIONS!

Asparagus Disease Control

Fusarium Crown and Root Rot - Obtain crowns from a reliable source. Dip roots in a captan solution (3 lb. Captan 50 WP per 100 gal.) before planting. Avoid fields with a history of crown and root rot. Disease is promoted by acid (low) pH and poorly drained, infertile soil.

Rust - Apply protective fungicides after harvest at 7-10 intervals. Protection of ferns during summer months is essential for good yields the following season. Fungicides recommended for rust control include Dithane M-45 (2 lb. per acre), Manex (4 pt. per acre), and Manzate 200 F (4 pt. per acre).

Bean Disease Control (dry, lima, and snap beans)

Anthracnose - Apply Manex (3 pt. per acre) or Dithane M-22 (2 lb. per acre) at the first sign of disease. Repeat applications at 7-10 day intervals. Do not apply within 5 days of harvest.

Bacterial blights - Use certified, western grown seed. Treat seed with Agri-Strep 500 (0.3 oz. per 100 lb. seed. To try to slow the spread of bacterial blight in the field, apply copper sprays (2 lb. fixed copper per acre) at 7-10 day intervals.

White mold - Avoid wet fields with a history of white mold. Apply Benlate (1 lb. per acre) or Topsin-M (1 lb. per acre) when about one fourth of the plants show blossoms. Repeat application 5-7 days later. Do not apply Benlate within 14 days of snap bean harvest or within 28 days of lima bean harvest.

Broccoli, Cabbage, and Cauliflower Disease Control

Alternaria Leafspot - Apply protective fungicides at the first sign of disease and repeat at 7-10 day intervals. Registered fungicides include Bravo 500 (2.25 pt. per acre), Dithane M-22 (1.5 lb. per acre), Manzate (1.5 lb. per acre), and Manex (3 pt. per acre). Rotation with crops other than crucifers will reduce pathogen populations and enhance fungicide effectiveness.

Black Leg - Obtain disease-free seed from a reliable source. Rotate with non-crucifer crops for 3-4 years. Apply Rovral 50 W (2 lb. per acre) to young plants (2-4 leaf stage) immediately after thinning. A second application may be made until the day of harvest.

Black Rot - Obtain disease free seed from a reliable source. Rotate infested fields with other crops for 3-4 years. Application of copper sprays may slow the spread of black rot. Several cabbage varieties have genetic resistance to black rot.

Club Root - Avoid poorly drained fields with a history of club root. Severely infested fields should be planted to crops other than crucifers for at least 7 years. Serious losses can be avoided by raising soil pH to 7.2-7.5. Plant only healthy, vigorous transplants.

Downy Mildew - Apply Ridomil/Bravo 81W at 1.5 lb. per acre at the first sign of disease. Second and third applications may be required and should be applied at 14 day intervals. Rotation with crops other than crucifers may reduce pathogen populations and improve fungicide efficacy.

Seed Contamination (Alternaria, black leg, black rot) - Use seeds treated with captan or thiram (most seed companies distribute treated seed). Hot water treatment is important to help prevent black leg and black rot.

Wirestem - Grow seedlings in seedbeds that are disinfested by steam or chemical fumigants. Apply Terraclor 75W to seedbeds (4-8 oz. per 500 gal. water per 1000 sq. ft. of soil surface).

Carrot Disease Control

Damping off and seed decay - Treat seed with 1 tsp. thiram 75 WP per lb. of seed. (Most seed companies deliver pre-treated seed).

Alternaria leaf blight and Cercospora leaf blight - Apply protective fungicides at the first sign of disease and repeat at 7-10 day intervals. Registered fungicides include Bravo 500 (2.25 pt. per acre), Dithane M-22 (2.0 lb. per acre), Dithane M-45 (2.0 lb. per acre), Manzate (2.0 lb. per acre), Manzate 200 F (4 pt. per acre), or Manex (3 pt. per acre). Do not apply Dithane M-45 or Manzate 200 within 7 days of harvest. Rotation with other crops will reduce pathogen populations and enhance fungicide effectiveness.

White mold - Apply Benlate (8 oz. per acre) at 7-10 day intervals at the first sign of disease. Rotate fields with other crops to prevent pathogen population increase.

Cucumber, Muskmelon, and Watermelon Disease Control

Damping off (Pythium): (greenhouse or coldframes) Apply Ridomil 2E at 2 fl. oz./1350 sq. ft. before seedlings emerge. Irrigate lightly after application. A second application may be necessary for seedlings held for more than 4 weeks. Post-emergence application at rates greater than 2 fl. oz./1350 sq. ft. may injure seedlings.

(field seeded crops): Apply Ridomil 2E at 2-4 pt./acre as a preplant broadcast spray in 50 gal. of water before or at time of seeding. Calibrate equipment accordingly for band applications over the row.
Seeds should be treated with captan or thiram (about 1/2 tsp./lb. seed) before planting. Most seed companies deliver pre-treated seed. Check the seed package to determine the kind of seed treatment used. If no treatment was applied, then treat seed with one of the fungicides mentioned above.

Alternaria leaf blight (muskmelon): Apply protective fungicides (Table 3) beginning when vines touch within rows or at first sign of the disease. Rotation with other crops will significantly decrease the threat of Alternaria problems.

Angular leaf spot (cucumber and muskmelon): Apply copper bactericides (Table 3) at the first sign of disease. Alternate or tank mix with fungicides to maintain protection from other diseases. Several cucumber cultivars have resistance to angular leaf spot.

Anthracnose (cucumber, muskmelon, watermelon): Apply fungicides (Table 3) at the first sign of disease or when vines touch within rows. Fungicides which protect against Alternaria and gummy stem blight infection also will protect against anthracnose. Many cucumber cultivars are resistant to anthracnose. Rotation with non-cucurbit crops will decrease incidence of anthracnose.

Bacterial wilt (cucumber and muskmelon): Control of this disease depends on control of striped and spotted cucumber beetles. A systemic insecticide (Furadan) should be incorporated into soil before transplanting. Contact insecticides such as Sevin, Pydrin, or Methoxychlor should be applied to seedlings before transplanting and then continued on a regular basis after the systemic insecticide loses effectiveness (4-5 weeks). Control must be maintained throughout the season.

Downy mildew (cucumber, muskmelon, watermelon): Apply Ridomil MZ-58 a systemic fungicide, at the first sign of disease. Most fungicides that protect against Alternaria and gummy stem blight also provide some downy mildew protection. Several cucumber cultivars have resistance to downy mildew.

Fusarium wilt (muskmelon and watermelon): Use resistant cultivars (see Table 4) in fields where wilt has been a problem in the past. Muskmelon cultivars Superstar and Saticoy and watermelon cultivars Royal Sweet, Royal Jubilee, and Prince Charles have good resistance to strains of Fusarium found in Indiana. Rotation with non-cucurbit crops will decrease incidence of wilt.

Gummy stem blight (cucumber, muskmelon, watermelon): Disease is most severe on watermelon. Apply protective fungicides (Table 3) beginning when vines touch within rows or at the first sign of disease. Rotation with other crops will significantly decrease the threat of gummy stem blight. Use disease-free seed and clean, uncontaminated growing trays for raising seedlings.

Nematodes (muskmelon and watermelon): Fumigate soil in fall with Telone II (16 gal. per acre) or Vorlex (12 gal. per acre) or apply Vydate L (1-2 gal. per acre in 20 gal. water broadcast) in spring before planting. Incorporate Vydate L 2-4 inches deep. Vydate L also can be applied as a foliar treatment 2-4 weeks after planting and repeated 2-3 weeks later.

Powdery mildew (cucumber and muskmelon): Apply fungicides (Table 3) at the first sign of disease. Saticoy and Summet are powdery mildew-resistant muskmelon cultivars. Many cucumber cultivars also are resistant to powdery mildew.

Scab (cucumber): Use scab resistant cultivars and rotate with non-cucurbit crops. Apply fungicides (Table 3) for scab protection.

Virus Diseases: Several virus diseases including cucumber mosaic virus, watermelon mosaic virus, squash mosaic virus, and zucchini yellow mosaic virus can occur in Indiana. Apply insecticides for aphid and cucumber beetle control because viruses are transmitted by these insects. Squash mosaic virus is seed transmitted. Inspect seedlings and discard those with virus-like symptoms. Obtain seed from reliable sources.

Table 3. Selected fungicides, application rates, application intervals, and harvest restrictions for **cucumber** and **melon** disease control. A "*" indicates preferred fungicides for disease control.

DISEASE	FUNGICIDE	RATE PER ACRE	SPRAY INTERVAL	HARVEST LIMIT
Powdery mildew	* Bayleton	2-4 oz.	10-14 (days)	0 (days)
	Benlate	8 oz.	7-10	0
	Topsin M	8 oz.	7-10	0
	Karathane WD	8 oz.	7-10	7
Alternaria leaf blight	* Bravo 500	3-4 pt.	7	0
	* Difolatan	2-3 lb.	7	5
	Dithane M-45	2-3 lb.	7	5
	Manzate 200 F	2 qt.	7	5
Anthracnose	Bravo 500	3-4 pt.	7	0
	Difolatan	2-3 lb.	7	0
Gummy stem blight	Bravo 500	3-4 pt.	7	0
	* Difolatan	2-3 lb.	7	5
	Dithane M-45	3 lb.	7	5
	Manzate 200 F	2 qt.	7	5
Downy mildew	Ridomil MZ-58	2 lb.	14	5
	Bravo 500	3-4 pt.	7	0
	Kocide 101	2-3 lb.	7	0
Scab	Bravo 500	3-4 pt.	7	0
	Difolatan	2 lb.	7	0
Angular leaf spot	Citcop 5E	3 pt.	7	0
	C-O-C-S	3-4 lb.	7	0
	Kocide 101	2-3 lb.	7	0

Table 4. Relative Fusarium wilt resistance of melon cultivars suited to Indiana and the Midwest. A resistance rating of "9" indicates excellent resistance, a rating of "1" indicates little or no resistance. Cultivars with a resistance rating less than "7" should not be planted in fields with a history of Fusarium wilt.

MUSKMELON CULTIVAR	RESISTANCE RATING	WATERMELON CULTIVAR	RESISTANCE RATING
Superstar	9	Royal Jubilee	9
Saticoy	8	Royal Sweet	9
Summet	6	Oasis	8
Zenith	6	Prince Charles	8
Burpee Hybrid	3	Allsweet	8
Classic Hybrid	3	AU Producer	7
Goldstar	3	Crimson Sweet	6
Star Headliner	3	Charleston Gray	5
Star Trek	3	Jubilee	3
Schoon's Hardshell	2	Mirage	3

Eggplant and Okra Disease Control

Verticillium wilt - Avoid fields with a history of Verticillium wilt. Rotate with small grains where possible to prevent rapid increase of pathogen populations. Fumigate with Vorlex (20-30 gal. per acre) or Vapam (60 gal. per acre) under plastic mulch. Allow at least 30 days between application of fumigant and transplanting.

Greens (Collard and Mustard) Disease Control

Downy mildew - Apply Dithane M-22 (2 lb. per acre), Manzate (2 lb. per acre), or Manex (3 pt. per acre) at 10 day intervals beginning at the first sign of disease.

Lettuce Disease Control

Bottom rot and Drop - Avoid wet fields with a history of disease and apply one of the following fungicides.

Rovral 50W (1.5-2.0 lb. per acre) beginning at the 3-leaf stage (head lettuce only). Repeat application in 10 days. A third application may be necessary if disease favorable conditions persist. Do not apply Rovral with 14 days of harvest.

Or Ronilan 50W (1.0-2.0 lb. per acre) beginning 7-10 days after transplanting (head lettuce only). Repeat application in 14 days. A third application may be necessary if disease favorable conditions persist. Do not apply Ronilan with 28 days of harvest.

Or, Botran 75W (5 lb. per acre). Do not apply Botran to leaf lettuce within 7 days of transplanting or within 14 days of harvest.

Downy mildew - Apply Dithane M-22 or Manzate (2.0 lb. per acre) or Manex (3 pt. per acre) at 10 day intervals beginning at the first sign of disease.

Onion Disease Control

Alternaria purple blotch - Apply protective fungicides (Table 5) at 7-10 day intervals beginning when disease first appears.

Botrytis leaf blight (blast) - Apply protective fungicides (Table 5) at 7-10 day intervals beginning when disease first appears.

Downy mildew - Some fungicides that protect against purple blotch and Botrytis leaf blight also will provide some protection against downy mildew (Table 5). At the first sign of mildew, apply a systemic fungicide (Ridomil, Table 5) at 14 day intervals.

Fusarium basal rot - Use Fusarium-resistant varieties such as Elba Globe, Spartan Banner, and Harvestmore. Consult seed catalogues for varietal characteristics.

Neck Rot - Wind-row plants until neck tissues are dry before topping and storage. Cure rapidly and properly. Artificial drying may be necessary (forced heated air at 93-95° F for 5 days).

Table 5. Selected fungicides, application rates, application intervals, and harvest restrictions for **onion** disease control.

DISEASE	FUNGICIDE	RATE PER ACRE	SPRAY INTERVAL	HARVEST LIMIT
Alternaria purple blotch and Botrytis leaf blight	Bravo 500	2.5-4.0 pt.	7 (days)	0 (days)
	Difolatan	1.5 lb.	7	0
	Dithane M-45	2.0-3.0 lb.	7	5
	Manzate 200	2.0-3.0 lb.	7	5
	Manzate	2.0 lb.	7	5
	Manex 4F	4.0 pt.	7	5
	Rovral	2.0 pt./lb.	14	0
Downy mildew	Ridomil MZ-58	1.5-2.0 lb.	14	5
	Ridomil /Bravo 81W	1.5 lb.	14	0
	Bravo 500	2.5-4.0 pt.	7	0
	Difolatan	1.5 lb.	7	0

Pea Disease Control

Fusarium wilt - Plant resistant cultivars.

Root rot - Rotate fields with a history of root rot with other crops for at least 4-5 years.

Pepper Disease Control

Anthracnose fruit rot - Apply Manzate at 2 lb. per acre or Manex at 3 pt. per acre at 10-14 day intervals beginning when fruit begin to form.

Bacterial spot - Use disease-free seed and/or transplants. Seedlings in seedbeds can be protected with applications of Agri-strep (1 lb. per 100 gal. water) repeated at 5 day intervals. Agri-strep cannot be applied to plants outside of the seedbed. To reduce the rate of spread of bacterial spot in the field, apply Manzate (2 lb. per acre) or Manex (3 pt. per acre) or Kocide 606 (4 pt. per acre) at 7-10 day intervals. Avoid consecutive seasons with peppers or tomatoes in the same field.

Phytophthora blight - Grow peppers in well drained fields where Phytophthora blight has not been a problem in the past. Planting on raised beds will increase soil drainage. Rotate infested fields with other crops for several years.

Potato Disease Control

Black Leg - Plant cut seed that has been stored under conditons for rapid healing of cut surfaces and treated with Dithane M-45 (1 lb. per cwt). Plant whole seed where possible.

Early Blight - Apply protective fungicides (Table 6) at 7-10 day intervals beginning when plants start to flower. Try to avoid droughty, wet, or compacted fields and other conditions (such as insufficient nitrogen fertilization) that might add undue stress to the crop and increase the susceptibility to early blight.

Fusarium Dry Rot - Treat potatoes with Mertect 340-F (2.5 pt./100 gal.) as they go into storage. The product should be applied uniformly as a fine mist. Avoid bruising at harvest. Cure potatoes in storage at 60 ° F before lowering temperature. Provide adequate ventilation.

Late Blight - Destroy cull piles. Apply protective fungicides (Table 6) at weekly intervals beginning when plants are 8"-12" tall. Apply Ridomil (Table 6) at the first substantiated report of late blight in the area.

Rhizoctonia - Avoid heavily infested fields and plant uncontaminated seed.

Scab - Use varieties that are less susceptible to scab (Norland, Onaway, Superior). Rotate scab-prone fields out of potatoes for 3-4 years. Maintain high moisture levels (near field capacity) during tuber set and enlargement. Avoid excessive liming and maintain an acid soil pH.

Verticillium Wilt - Employ at least a 2 year rotation with small grains to manage fungus populations in the soil. Good weed control also is important in reducing pathogen populations.

Table 6. Selected fungicides, application rates, application intervals, and harvest restrictions for **potato** disease control.

DISEASE	FUNGICIDE	RATE PER ACRE	SPRAY INTERVAL	HARVEST LIMIT
Early blight	Bravo 500	2.0-3.0 pt.	7 (days)	0 (days)
	Difolatan	1.5-2.0 lb.	7	0
	Dithane M-45	3.0 lb.	7	5
	Manzate 200	3.0 lb.	7	5
Late blight	Ridomil MZ-58	1.5-2.0 lb.	14	7
	Ridomil/Bravo 81 W	1.5-2.0 lb.	14	0
	Bravo 500	2.0 pt.	7	0
	Difolatan	1.5-2.0 lb.	7	0

Spinach Disease Control

Downy mildew - Apply Dithane M-22 (2 lb. per acre), Manzate (2 lb. per acre), Manex (3 pt. per acre), or basic copper sulfate (3 lb. per acre) at 10 day intervals beginning at the first sign of disease.

White Rust - Apply Dithane M-22 (2 lb. per acre), Manzate (2 lb. per acre), Manex (3 pt. per acre), or basic copper sulfate (3 lb. per acre) at 10 day intervals beginning at the first sign of disease.

Squash and Pumpkin Disease Control

Anthracnose - Apply protective fungicides (Table 7) where fields with a history of anthracnose are used for squash or pumpkin production.

Bacterial wilt - Use systemic and non-systemic insecticides for cucumber beetle control. Consult section on bacterial wilt control for cucumbers and melons.

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Black rot - Avoid fields with a history of black rot of squash and pumpkin or gummy stem blight of cucumbers and melons. When disease threatens, apply protective fungicides (Table 7) at 7-10 day intervals. Rotate fields with other crops to prevent rapid increase of fungus populations.

Downy mildew - Cucurbit downy mildew usually first appears in Indiana in late August or early September. One or two applications of a systemic fungicide (Ridomil, Table 7) may be economically feasible. Apply Ridomil only after downy mildew has been positively identified.

Powdery mildew - Apply fungicides (Table 7) at 14 day intervals beginning at the first sign of disease.

Table 7. Selected fungicides, application rates, application intervals, and harvest restrictions for **squash** and **pumpkin** disease control.

DISEASE	FUNGICIDE	RATE PER ACRE	SPRAY INTERVAL	HARVEST LIMIT
Anthracnose	Bravo 500	3.0-4.0 pt.	7-10 (days)	0 (days)
	Manzate 200 F	2.0 qt.	7	5
Black rot	Bravo 500	3.0-4.0 pt.	7-10	0
	Manzate 200 F	2.0 qt.	7	5
Downy mildew	Bravo 500	3.0-4.0 pt.	7-10	0
	Ridomil MZ-58	1.5-2.0 lb.	14	5
	Ridomil/Bravo 81	1.5 lb.	14	0
Powdery mildew	Bayleton	2.0-4.0 oz.	14	0
	Benlate	8 oz.	10-14	0
	Karathane WD	8 oz.	7-10	7
	Topsin M	8 oz.	10-14	0

Sweet Corn Disease Control

Seed rot and damping off- Treat seed with captan (1 tsp. of Captan 50 W per lb. of seed). Most seed companies deliver pre-treated seed.

Rust - Fungicide application is justified where severe disease outbreaks occur early in the season. In those cases where a fungicide spray is warranted, apply Bravo 500 at 2 pt. per acre and repeat at 7 day intervals beginning before tassel emergence and ear formation (do not feed treated forage to livestock). Do not apply Bravo less than 14 days before harvest.

Smut - Use tolerant hybrids such as Apache, Bellringer, Commanche, Comet, Gold Cup, and Merit.

Stewart's wilt - Control flea beetles, especially after mild winters. Use wilt-tolerant hybrids: Apache, Bellringer, Comet, Gold Cup, Commanche, Merit, and Silver Queen.

Sweet Potato Disease Control

Black rot, Scurf - Dip roots and sprouts in Mertect 340 F (8 fl. oz. per 7.5 gallons water) or thiram 75W (1 lb. per 7.5 gallons water) for 2 minutes and plant immediately. Rotate fields out of sweet potatoes for at least two years.

Pox (soil rot) - Maintain acid soils for sweet potato production (pH 5.0). Use disease free roots and sprouts. Warning: soils with low pH values are not recommended for raising other vegetable crops!

Tomato Disease Control

Damping off (Pythium): Greenhouse or coldframes - Apply Ridomil 2E at 2 fl. oz./1350 sq. ft. before seedlings emerge. Irrigate lightly after application. A second application may be necessary for seedlings held for more than 4 weeks. Post-emergence application at rates greater than 2 fl. oz./1350 sq. ft. may injure seedlings. **Field seeded crops -** Apply Ridomil 2E at 2-4 pt./acre as a preplant broadcast spray in 50 gal. of water before or at time of seeding. Calibrate equipment accordingly for band applications over the row.
Seeds should be treated with captan or thiram (about 1/2 tsp./lb. seed) before planting. Most seed companies deliver pre-treated seed. Check the seed package to determine the kind of seed treatment used. If no treatment was applied, then treat seed with one of the fungicides mentioned above.

Anthracnose: Rotate out of fields with a history of anthracnose. Apply protective fungicides (Table 8) at regular intervals.

Bacterial Canker: Obtain disease-free seed and/or transplants from a reliable source. Fields with a history of canker should be planted to crops other than tomatoes, potatoes, peppers and eggplant for at least three years. Sanitize machinery and plant production materials (wooden flats, plastic trays, greenhouse benches and wooden stakes) with a 10% chlorine bleach solution. Avoid working in fields with canker when foliage is wet. Copper sprays are not effective in controlling canker.

Bacterial Speck and Bacterial Spot: Seed bed treatment - Apply Agri-Strep at 1 lb. per 100 gal. water (200 ppm) to seedlings when first true leaves appear and repeat applications at 5 day intervals. Agri-strep is registered for use on tomato seedlings only before they are transplanted into the field. **Field treatment -** Apply copper sprays (Table 8) at 5-7 day intervals beginning when disease first appears. Bacterial speck is more likely to spread in cool wet weather; bacterial spot is favored by warm wet weather.

Blossom End Rot: This is a physiological disorder related to a deficiency of calcium in the plant. Rot is promoted by fluctuations in available water and excessive vine growth rates. Some processing tomato cultivars are less prone to blossom end rot than others.

Buckeye Rot: Apply Ridomil 2E at 4 pt. per acre as a soil surface application under vines. Do not apply Ridomil 2E less than 28 days before harvest.

Early Blight: Rotate out of fields with a history of early blight. Apply protective fungicides (Table 8) at regular intervals.

Fusarium and Verticillium Wilts: Use wilt resistant "VF" cultivars and avoid fields with a history of wilt problems.

Late Blight: Apply protective fungicides (Table 8) at regular intervals. At the first sign of disease apply Ridomil MZ-58 (2 lb. per acre) or Ridomil/Bravo 81W (2 lb. per acre). Repeat applications at 14 day intervals.

Sclerotinia Stem Rot: Use disease-free transplants. Avoid fields with a history of stem rot.

Septoria leaf blight: Apply protective fungicides (Table 8) at regular intervals beginning when adjacent plants touch within rows. Avoid fields where Septoria has been a problem in the past.

Table 8. Selected fungicides, application rates, application intervals, and harvest restrictions for **tomato** disease control.

DISEASE	FUNGICIDE	RATE PER ACRE	SPRAY INTERVAL	HARVEST LIMIT
Anthracnose	Bravo 500	3.0-4.0 pt.	7-10 (days)	0 (days)
Early blight	Difolatan**	1.5-3.0 lb.	7-10	0
and	Dithane M-45	3.0 lb.	7-10	5
Septoria leaf	Dithane F-45	4.0 pt.	7-10	5
blight	Manzate 200	3.0 lb.	7-10	5
	Manzate 200 F	4.0 pt.	7-10	5
	Manex 4F	3.0 pt.	7-10	5
Late blight	Ridomil MZ-58	1.5-2.0 lb.	14	5
	Ridomil/Bravo 81W	1.5-2.0 lb.	14	0
	Bravo 500	3.0-4.0 pt.	7	0
	Difolatan*	1.5-3.0 lb.	7	0
	Dithane M-45	3.0 lb.	7	5
	Dithane F-45	4.0 pt.	7	5
	Manzate 200	3.0 lb.	7	5
	Manzate 200 F	4.0 pt.	7	5
	Manex 4F	3.0 pt.	7	5
Bacterial speck	Tribasic Copper			
and	Sulfate 53 W	2.0-4.0 lb.	7-10	0
Bacterial spot **	Kocide 101	2.0-4.0 lb.	7-10	0
	Kocide 606	3.0-4.0 pt.	7-10	0
	COCS	5.0 lb.	7-10	0

* Difolatan is registered for use only on mechanically harvested tomatoes.
** Bacterial speck and bacterial spot are caused by bacteria (not fungi), therefore products listed for control of these diseases are bactericides (not fungicides).